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12/13/00

STAFF SUMMARY

TO: Board of Directors
FROM: Douglas B. MacDonald, Executive Director
DATE: December 13, 2000
SUBJECT: Update on Framingham Extension Relief Sewer Corrosion and Odor Control

COMMITTEE: Wastewater Policy and Oversight

X Information
____ Vote

Robert C. Kovacs, Sr. Program Manager
Charles W. Lombardi, Director, Transport
Kevin McManus, Director, TRAC
Preparer/Title

Michael J. Hornbrook
Chief Operating Officer

RECOMMENDATION:

For information only. This staff summary is the seventh update since the Board's request last January for regular reports on the status of the corrosion and odor problems in the Framingham Extension Sewer, Framingham Extension Relief Sewer, and downstream MWRA interceptors.

DISCUSSION:

The primary purpose of this update is to provide a summary of the data obtained in the recently conducted sampling program, an analysis of the data and the preliminary findings reached through review of the data. An update on the status of the other ongoing initiatives is provided in Attachment A.

MWRA staff have conducted intensive sampling within the Framingham Extension Sewer system as part of the effort to identify and remediate severe odor and corrosion impacts. During the past several months, staff have been involved in several specific sampling projects beyond the work at the designated municipal sampling sites. These include sampling of:

- Hydrogen sulfide gas levels in downstream interceptors;
- A high sulfate industrial discharge (Nyacol Nano Technologies) before, during, and after a two-week shut down period;
- Additional industrial discharges within Ashland, Framingham, and Natick;
- Other parts of the MWRA system with similar characteristics to the Framingham Extension Sewer with the exception of the high corrosion rates.

A brief description of each sampling activity identified above, a summary of the results, and an analysis and findings are presented below. The various sampling locations are shown on Attachment B.

Summary of Hydrogen Sulfide Gas Monitoring in Downstream Interceptors

Four key downstream monitoring locations within the MWRA regional system have been identified at which significant hydrogen sulfide concentrations have been measured. The specific hydrogen sulfide gas measurement location is in the manhole cone between one and four feet below the cover. Eleven weeks of data for these locations have been compiled and are graphed below, with the maximum and average hydrogen sulfide reading at each location identified on Figures 1 and 2, respectively, for each week.

The four key locations and their significance are as follows:

SL13 – A manhole on the Framingham Extension Sewer immediately adjacent to the Arthur Street Pump Station just prior to the injection point of potassium permanganate. All of the wastewater from Ashland and Framingham flows through this manhole. This location is also immediately downstream of the discharge of two force mains within the Framingham municipal sewer system;

Figure 1

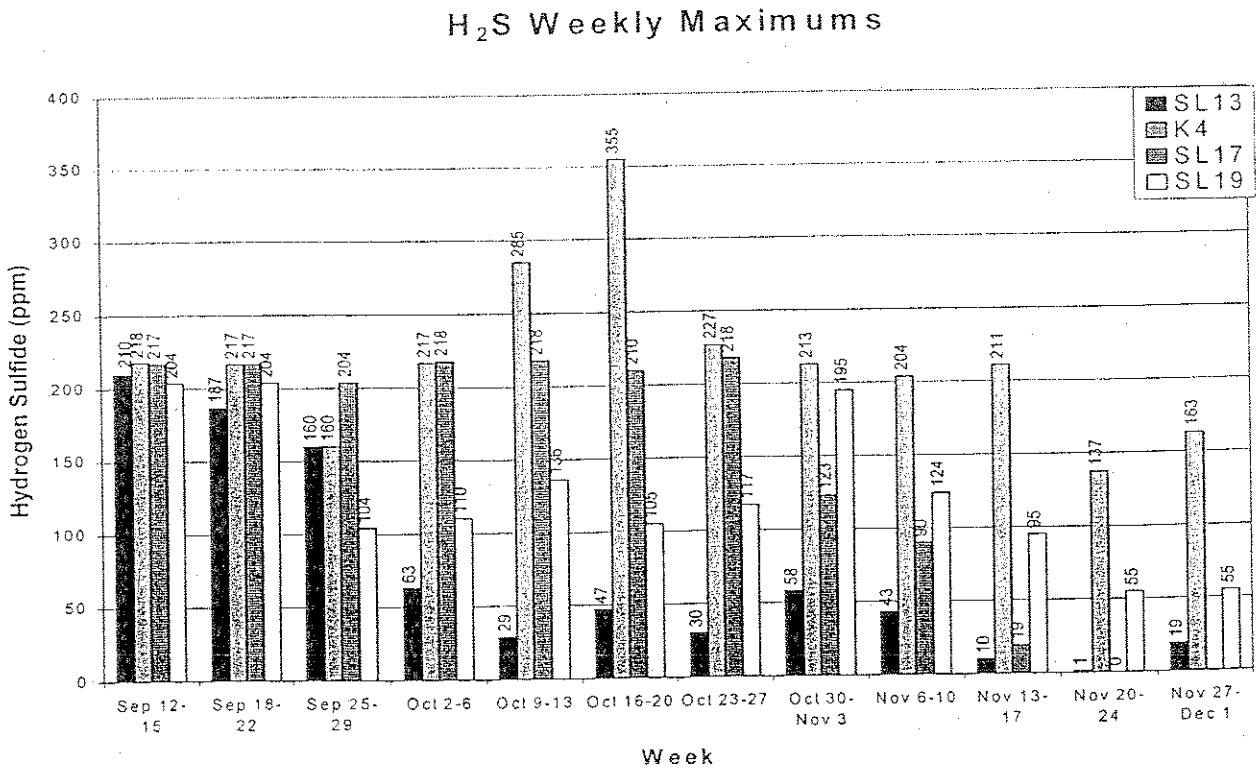
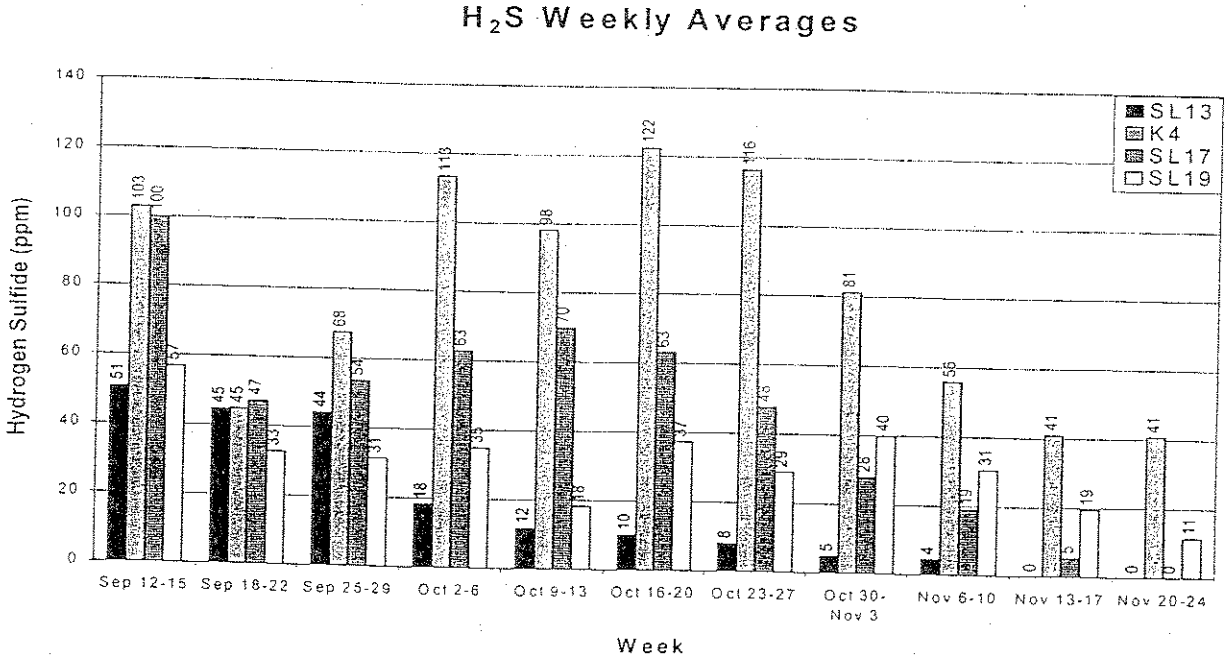


Figure 2



K4 – A manhole on the Framingham Extension Sewer immediately upstream of the Eliot Street Siphon underneath the Charles River in South Natick. The siphon prohibits the continued flow of air that is pulled along with the wastewater flow in the gravity sewers because it does not have an air jumper (additional pipe to convey air). The air, which contains the hydrogen sulfide generated in the sewer, collects at this location, and eventually escape to the atmosphere through leaks in system manholes and their covers. This location represents the likely worse case for high levels of hydrogen sulfide within the Framingham Extension Sewer;

SL17 – A manhole at the junction of the Framingham Extension Sewer and the Framingham Extension Relief Sewer on the Elm Bank in Dover. It is also just upstream of the siphon underneath the Charles River connecting with the downstream Wellesley Interceptors, and also does not have an air jumper;

SL19 – A manhole on the Wellesley Extension Sewer Replacement at Chestnut Street in Needham. It provides hydrogen sulfide concentrations at a downstream location, and also includes wastewater flows from Wellesley.

A review of the data indicates that the hydrogen sulfide gas concentrations are very high. The levels in the system are generally above the OSHA short-term exposure level of 15 ppm and are close to the "immediate danger to life and health" value of 100 ppm. The data also clearly indicates a downward trend since mid-October in hydrogen sulfide gas concentrations in the downstream interceptors. This is directly attributable to the seasonal reduction in air and water temperatures that inhibit the biological processes that generate the hydrogen sulfide gas. The dosage rate for potassium permanganate has been maintained at 660 pounds per day through most of the monitoring period, but has been reduced to 330 pounds per day on December 1,

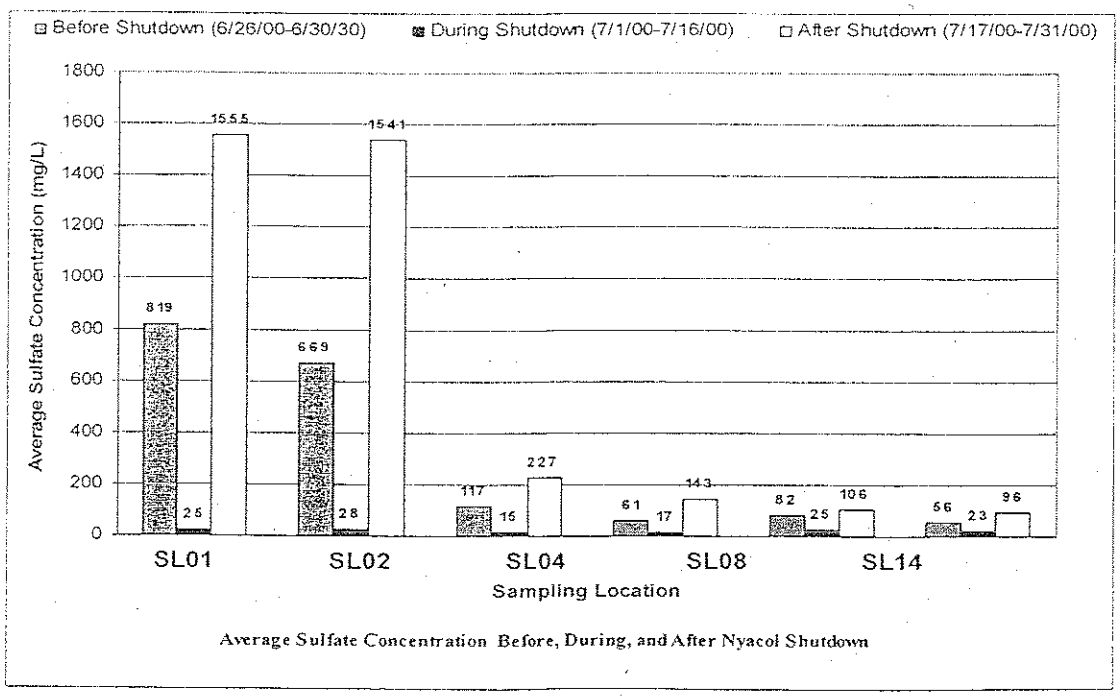
2000, to reflect the lower chemical demand due to the reduced temperatures. Staff intend to proceed with the interim facility installation and permanent monitoring program, and increase the dosage rate during peak demand periods in the future to attempt to reduce the hydrogen sulfide gas concentrations. More data is needed, both during different periods of the year, and at different dosage rates to reach definitive conclusions about the effectiveness of the potassium permanganate chemical addition program.

Summary of Sampling Conducted Before, During, and After Nyacol Shutdown

Nyacol Nano Technologies is a high sulfate discharger in to the Ashland Sewer System directly upstream from the Chestnut Street Pump Station in Framingham. The literature on sulfide generation in sewers has focused primarily on the effects of biological oxygen demand (BOD) and temperature. Few studies have looked at the effect of high sulfate discharges on sulfide generation in sewers. Nyacol annually suspends its operations for two weeks in July. Staff developed a sampling program to monitor the levels of sulfate, sulfide, and BOD in downstream sewers before, during, and after the shutdown. Temperature and pH were also measured. Six locations were sampled, four in the municipal sewers downstream from Nyacol, and two downstream in the Framingham Extension Sewer.

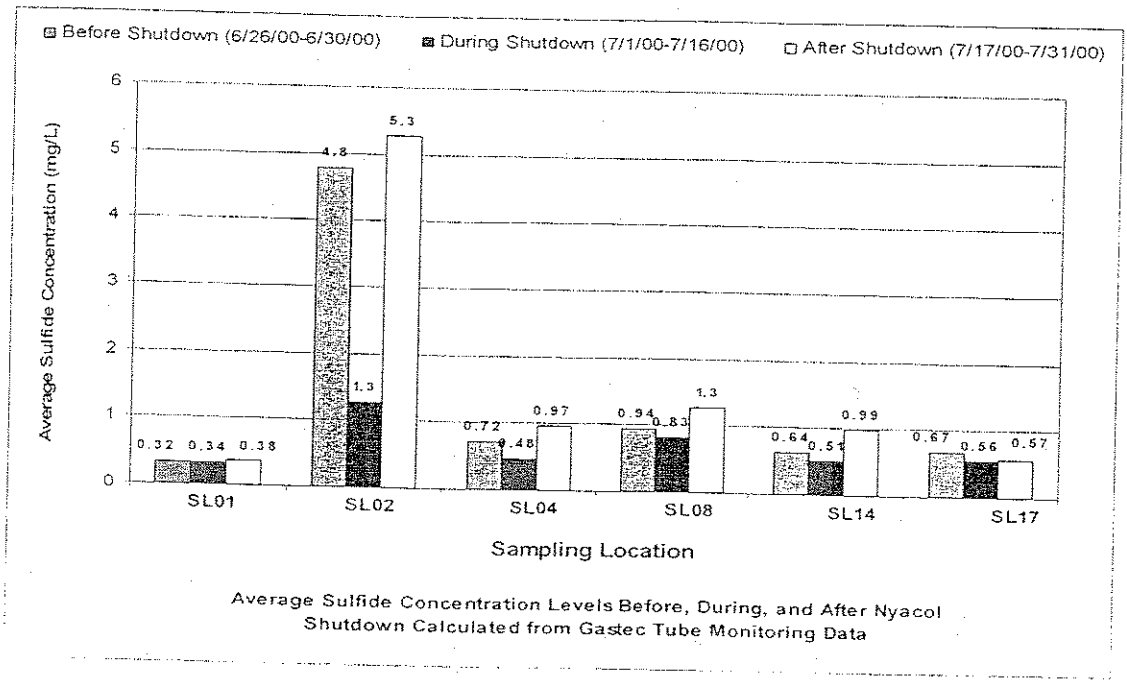
A summary of the data is presented in two graphs below. Figure 3 shows average sulfate loadings at all six sampling locations before, during, and after the shutdown. This graph illustrates the fate of sulfate over time as it moves downstream. Figure 4 presents the average sulfide concentrations at all six locations before, during, and after the shutdown. This graph provides information on the generation of sulfide that occurs as wastewater moves downstream.

Figure 3



Average Sulfate Concentration Before, During, and After Nyacol Shutdown

Figure 4



Average Sulfide Concentration Levels Before, During, and After Nyacol Shutdown Calculated from Gastec Tube Monitoring Data

The trend illustrated in Figure 3 is that sulfate levels at the sampling points drop significantly during the shutdown and rise again after production (and discharge) resumes. Figure 4 indicates that the sulfide concentrations at these locations follow a similar course, dropping significantly during shutdown (from 30-70% at sites directly downstream). As with the sulfate concentrations, sulfide rises after production resumes. These data demonstrate the link between upstream sulfate levels and downstream sulfide concentrations.

These data also illustrate that sulfate levels in the sampling points immediately downstream from Nyacol's discharge during the shutdown are comparable to those observed elsewhere in the system. Therefore, when the high sulfate discharge ceases, the sulfate concentrations return to levels typically seen in wastewater. However, Figure 4 also shows that sulfide loadings continue to rise downstream, suggesting that there are other influences on sulfide production beyond the initial concentration of sulfate in the wastewater.

Temperature, residence time in a force main, and the levels of BOD present are also factors influencing the generation of sulfide downstream. Sulfide levels increase as BOD levels and wastewater temperature increase. Sulfide levels in force mains increase as residence times increase. The most dramatic increase in sulfide levels over time appears to occur in a force main as residence time and BOD levels increase.

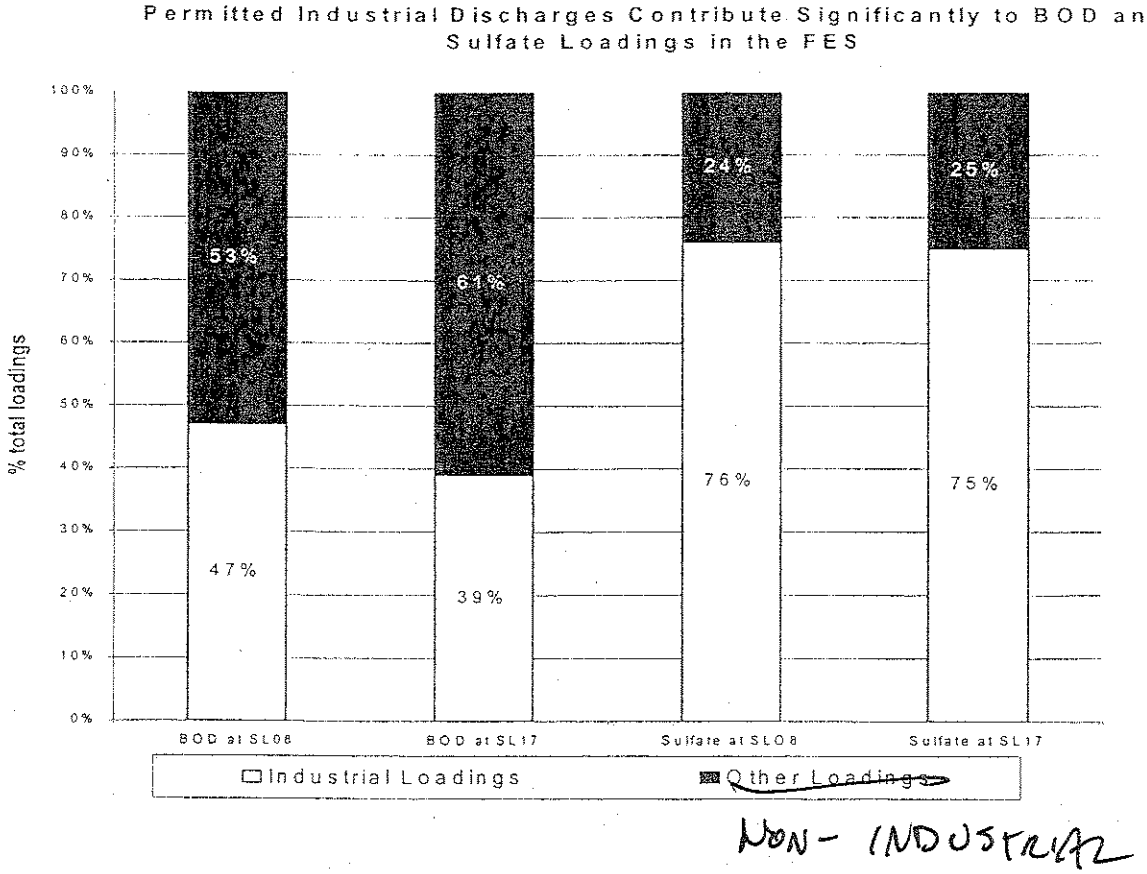
These factors contribute to increases in sulfide production downstream.

Summary of the Impact of Additional Industrial Loadings to the FES

There are additional industries discharging into the Ashland, Framingham, and Natick sewers, including a high BOD discharger, Good Humor/Breyers Ice Cream. Approximately twenty-two industries were sampled during the months of July, August, and September for the same parameters as Nyacol, (sulfate, sulfide, BOD, temperature, and pH).

Figure 5 shows the percentage of BOD and sulfate loadings in the Framingham Extension Sewer, contributed by permitted industries as compared to the total loadings for each parameter. As Figure 5 shows, about 40% to 50% of the BOD loading is attributable to permitted industrial discharges and about 75% of the sulfate loadings in the Framingham Extension Sewer can be attributed to permitted industrial discharge. Two industries contribute 94% of the permitted industrial contribution of BOD to the Framingham Extension Sewer and one industry contributes 96% of the permitted industrial contribution of sulfate to the Framingham Extension Sewer.

Figure 5



Sampling Conducted In Other Parts Of The MWRA System With Similar Characteristics To The Framingham Extension Sewer

Sampling was conducted in two other parts of the MWRA sewer system in order to compare the sulfate, sulfate, and BOD levels found in the Framingham Extension Sewer to these areas. Areas were selected based on general similarity of conditions to the Framingham Extension Sewer, except for the presence of the high corrosion and odor rates. The two areas selected were the North Metropolitan Sewer and the Randolph Trunk Sewer. Multiple samples were taken before a force main, just after the force main, and then further downstream from the force main. Table 1 (below) compares the average data from these two sites with the average data for the Framingham Extension Sewer. These data indicate that the strength of the wastewater in these two areas is lower than that of the wastewater in the Framingham Extension Sewer. MWRA's consultant has indicated that the data from the North Metropolitan Sewer and the Randolph Trunk Sewer represents more typical wastewater values.

Table 1

Parameter	North Metropolitan Sewer Sampling (mg/l)	Randolph Trunk Sewer Sampling (mg/l)	Framingham Extension Sewer (mg/l)
BOD	253	187	283
Sulfate	69	40	115
Sulfide (aqueous)	.20	.16	.95

Preliminary Findings from the Sampling Program

Key findings to date include:

- The Framingham Extension Sewer and downstream interceptors appear to have a higher strength (and more corrosive) wastewater than other parts of the MWRA system.
- The regulated industries' contribution to observed loadings of BOD and sulfate are substantial.
- Resulting sulfide levels in the MWRA and municipal systems are impacted by industrial discharges.
- Controls on industry alone is unlikely to fully eliminate odor and corrosion problems.

These data confirm that there are multiple factors contributing to the observed Framingham Extension Sewer odor and corrosion problem.

Future Actions

Montgomery-Watson will be meeting with staff in December to discuss its findings and options under consideration for addressing the odor/corrosion problems. This information will be submitted in its report for MWRA review by mid-January. Staff intends to review the options with the Board of Directors in the next update in February 2001. The options will then be presented to the municipal and industrial representatives in March 2001. Montgomery-Watson will review the comments received and prepare their final conclusions and recommendations.

BUDGET/FISCAL IMPACT:

No new information has been developed or is available concerning the fiscal impact of this multifaceted program.

ATTACHMENTS

A – Update on Status of Corrosion and Odor Control Initiatives
B – Framingham Extension Sewer System Sampling Sites

Attachment A
Update on Status of Corrosion and Odor Control Initiatives

The activities to address the corrosion and odor control problems that have occurred during the past two months are described below:

Temporary Chemical Addition Facility at the Arthur Street Pump Station

Design by in-house staff has been completed on an interim potassium permanganate feed facility at MWRA's Arthur Street Pump Station. The pre-cast concrete building to house this facility was delivered on November 21, 2000. The design documents for the equipment and materials to be used by staff to complete this facility were issued in order to procure the materials and proceed with construction of the chemical feed facility. The chemical feed equipment is to be shipped from the factory on or before December 21, 2000. This chemical feed facility is on schedule to be completed and operational by the end of December 2000. One of three chemical feed units purchased for this facility has been installed in the existing chemical feed area of the pump station and is being used to feed potassium permanganate on a temporary basis until the interim facility is ready. Potassium permanganate has been added since July 28, 2000, and will continue to be added from this temporary facility until the interim facility is ready for operation.

Hydrogen Sulfide Monitoring in Downstream Interceptors

Design by in-house staff was completed for the installation of 13 hydrogen sulfide gas monitors at locations identified in the Framingham Extension Sewer, Framingham Extension Relief Sewer, Wellesley Extension Relief Sewer, Wellesley Extension Sewer Replacement, West Roxbury Tunnel and the High Level Sewer. A contract to perform this work was advertised for bids on October 28, 2000. One bid was received and opened on November 28, 2000. The installation is scheduled to be completed by March 2001, which is three months later than planned due to problems in resolving access routes to several of the locations. Until this system is operational, a contractor has been hired to install and monitor temporary hydrogen sulfide gas meters. The temporary metering began on September 12, 2000 with hydrogen sulfide sampling data reported to staff daily. The temporary metering began six weeks later than planned due to problems in obtaining approval to award the work to the selected contractor.

Limits for Sulfate, Sulfide and BOD

Staff has completed the collection of wastewater samples for sulfide, sulfate and BOD from local industries and the municipal systems in Ashland, Framingham and Natick for this year. As detailed in previous staff summaries, there have been several exceedances of the planned 0.3 mg/l sulfide limit within the 11 sampling sites in the three communities. The most recent results have generally shown decreasing levels of sulfide. However, some exceedances (between 0.3 and 0.53 mg/l) were still observed in October and November 2000. In general, the higher flows and cooler temperatures that occur during the fall tend to reduce sulfide generation within the sewer system.

Staff will be issuing the CY2001 municipal permits for all MWRA sewer communities shortly, and have included the 0.3 mg/l limit on sulfide for the communities of Ashland, Framingham and Natick. Although the communities have continued to express concern about the application of this limit prior to the completion of the Montgomery-Watson study, staff believe that the limit is an important mechanism to maintain progress on implementing remedial measures within the municipal systems. In any event, sampling under the new permit requirements will not commence until April 2001.

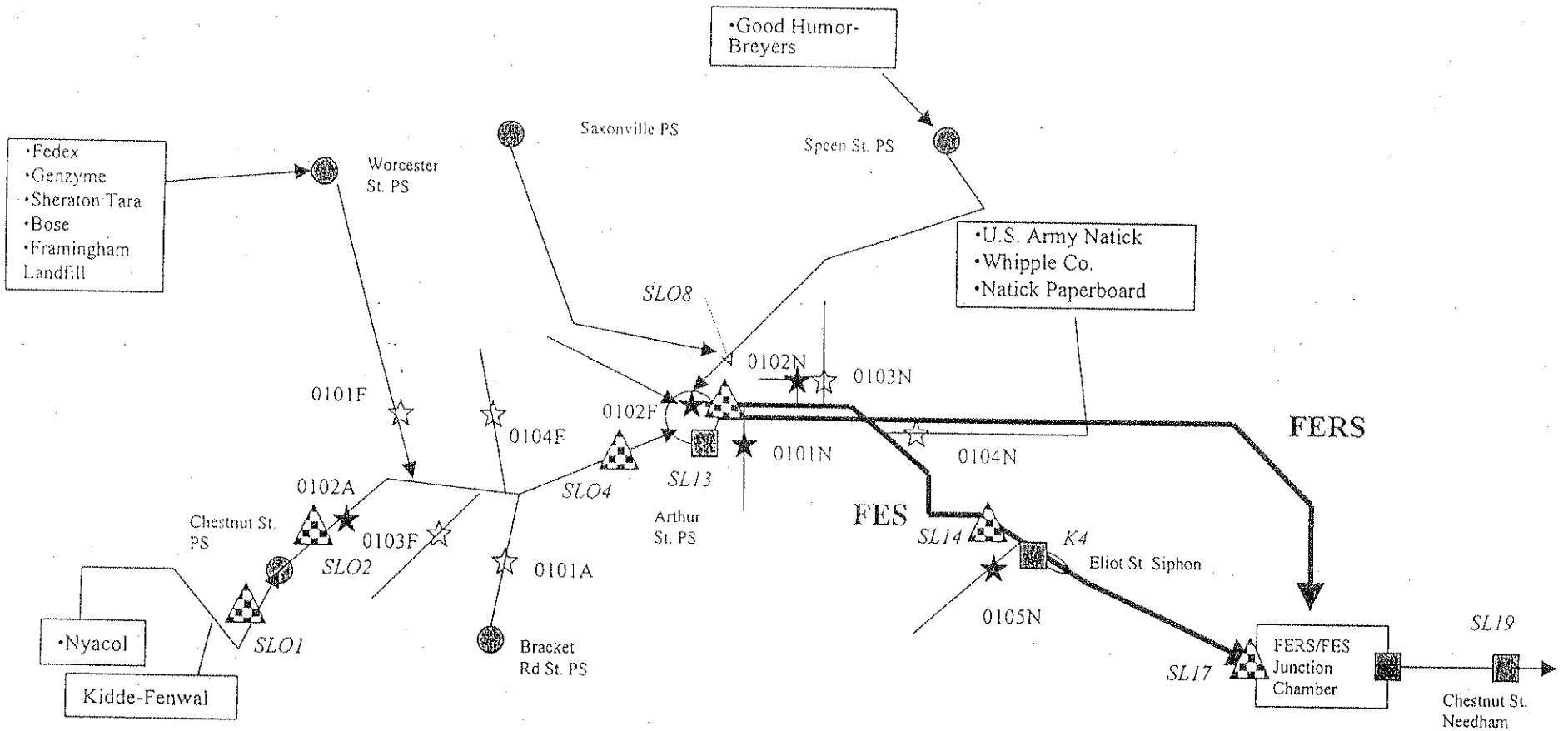
Meetings with Affected Communities

Staff are continuing to work closely with Ashland, Framingham and Natick representatives on this issue, providing technical assistance and guidance on dealing with elevated sulfide concentrations in their wastewater. Staff conducted a workshop with municipal and industrial representatives on October 24, 2000 at which the data collected during the summer sampling effort was presented. The planned CY01 municipal permit issuance process, an engineering update on planned system rehabilitation/repairs and a status report on the Montgomery-Watson study efforts were also presented. The Town of Ashland representative provided an update on the Town's chemical addition program. The Town of Framingham requested that imposition of the 0.3 sulfide limit on January 1, 2001 be delayed, and staff have recently met with town officials to discuss this further. Staff anticipate conducting the next workshop with municipal and industrial representatives to discuss alternative control strategies in March 2001.

The Town of Ashland began to add sodium nitrate to the wastewater within its sewage system starting on August 1, 2000. Staff will be meeting separately with town officials and their consultants to review respective sampling results and evaluate the impact of this upstream dosing program.

In response to concerns expressed at earlier community meetings, a sampling program was also conducted for other communities that discharge into the downstream interceptors. Wastewater samples were obtained and analyzed for sulfide, sulfate and BOD from several of the connections from Wellesley, Needham, Newton and Brookline into the Wellesley Extension Replacement Sewer and West Roxbury Tunnel to determine the extent these communities may be contributing to the corrosion and odor problem. There have been some exceedances of the 0.3 mg/l limit for sulfides in the discharges from Wellesley and Needham connections. As a result, sulfide limits for these communities are also under consideration. Staff met with the municipal officials from those two communities on November 4, 2000, to discuss these results and the need for sulfide control measures. The representatives of the two communities recognized that there were areas in their systems that generate hydrogen sulfide related odor problems. The two communities will be invited to participate in future workshops.

Attachment B: Framingham Extension Sewer System Sampling Sites



☆ Municipal Permit Site (no sulfide limit exceedances recorded)

★ Municipal Permit Site (0.3 mg/l sulfide limit exceeded)

▩ Hydrogen Sulfide Gas Monitoring Sites

△ Nyacol Shutdown Sampling Sites *(in italics)*

Rehabilitation of Downstream Interceptors

Framingham Extension Sewer

The construction Notice to Proceed for Contract 5342, Rehabilitation of the Framingham Extension Sewer was issued to Insituform Technologies, Inc., on October 31, 2000. This contract involves the rehabilitation of approximately 14,000 feet of the Framingham Extension Sewer in Natick and Dover, at a cost of $12,570,000. Construction is scheduled to be completed by August 2002. A compliance report was issued to Massachusetts Department of Environmental Protection and U.S. Environmental Protection Agency on November 9, 2000 in conjunction with the Administrative Compliance Order for this project notifying them of the start of construction. Staff conducted public meetings on the project on November 13 and 15, 2000 in Dover and Natick, respectively, to introduce MWRA and Contractor representatives and discuss construction related issues.

West Roxbury Tunnel

JE/Sverdrup essentially completed the design for the lining of 1000 feet of Wellesley Extension Relief Sewer upstream of the West Roxbury Tunnel and the rehabilitation of the New Haven Drop Chamber at the entrance to the tunnel. The 100% complete design documents were submitted to MWRA for review on October 16, 2000 in accordance with the schedule for this project. Staff provided JE/Sverdrup with comments on the design on November 2, 2000 and the Consultant is addressing the comments. Applications for the various permits required for the project are being prepared by JE/Sverdrup and are expected to be submitted to the various permitting agencies within the next two weeks.

The proposed construction is expected to have significant impacts within the neighborhood. The proposed construction at New Haven Street will require temporary easements on at least four residential properties, with the excavation as close as 20 feet to one of the homes. The construction will involve the installation of trench support around the excavation and will involve heavy construction activities, with the associated noise and dust, for approximately nine months. While the contractor will be required to control odors from the sewer during that period of time, it is expected that noticeable odor levels will be impossible to avoid in the neighborhood at times during construction. Temporary relocation of the families in the four homes directly affected by the construction may be necessary. Staff met with the four directly affected property owners on October 24, 2000 and November 9, 2000 to review the proposed project and its likely impacts. In order to assist in this process, a relocation agent is to be engaged as a subcontractor to JE/Sverdrup. JE/Sverdrup received three proposals for these services and after consultation with staff selected O.R. Colan Associates on November 16, 2000. Staff met with representatives of O.R. Colan Associates on November 27, 2000 to establish the procedures for further discussions with the property owners. Staff also met with representatives of commercial interests affected by the project on November 20, 2000. Additional neighborhood and public meetings on the project will be held in January 2001. Staff will continue to identify and resolve necessary mitigation actions and obtain the necessary easements and permits so that the construction contract can be advertised for bids as planned in January 2001.